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UNITED STATES PATENT APPLICATION

OF

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FOR

DUAL-MOTOR DRUM-TYPE WASHING MACHINE

[0001] This application claims the benefit of Korean Application No. 10-2002-0078807 filed on December 11, 2002, which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates to a drum-type washing machine, and more particularly, to a dual-motor drum-type washing machine, in which a washing motor and a dewatering motor are separately provided, and a pair of drums are employed, to enable a dual-drum motion effect.

Discussion of the Related Art

[0003] Generally, a drum-type washing machine performs washing using a frictional force between laundry and a drum, which is rotated by a transferred driving force of a motor with detergent, water, and the laundry placed in the drum. Such a drum-type washing machine prevents the laundry from being damaged and entangled and brings about such washing effects as beating and rubbing.

[0004] Referring to FIG. 1, illustrating a drum-type washing machine according to a related art, a cylindrical tub 2 made of a stainless steel based material is installed within a cabinet 1, and a cylindrical drum 3 is rotatably installed within the tub 2.

[0005] A motor 5 is installed at one side under the tub 2, and a motor pulley 151 is connected to the motor 15 by a shaft.

[0006] A drum shaft 31 is installed at a rear side of the drum 3, and a drum pulley 32 is installed at a rear end of the drum shaft 31. The drum pulley 32 is rotatably coupled with the motor pulley 151, which is rotatably connected to the motor 15 via a belt 16 as a power transfer element.

[0007] A suspension spring 24 is installed between the inner surface of the upper part of the cabinet 1 and the outer surface of an upper part of the tub 2, to support the tub 2; and a friction damper 25 is installed between the inner surface of the lower part of the cabinet 1 and the outer surface of a lower part of the tub 2, to attenuate vibrations that develop in the tub 2 on dewatering.

[0008] Meanwhile, the tub 2 consists of a tub cover 21 forming the front of the tub 2, a tub body 22 forming the sidewall of the tub 2, and a back cover 23 forming the rear of the tub 2. A bearing housing 4, in which bearings 4a and 4b are installed, is assembled at the rear of the drum 3, to be fixed to a central portion of the back cover 23 and receive the drum shaft 31.

[0009] Three wing portions 41 are integrally formed to radiate from the 120° points about the circumference of the bearing housing 4. End portions of the wing portions 41 are fixed to a rear end of the tub body 22 by a fixing bracket 14 and a bolt 8, which are assembled to be fixed to the back cover 23.

[0010] Meanwhile, since the back cover 23 made of stainless steel and the motor 15 are installed at the rear side of the tub 2 and thus generate a weight unbalance of the tub 2, a balance weight 26 is provided to a front side of the tub 2 for compensation.

[0011] The above-constructed drum-type washing machine is driven by the motor 15, which is typically a brushless DC (BLDC) motor, a universal motor, or the like. These motors are advantageous in that their rotational speed and direction can be accurately controlled but are expensive to manufacture, and their use results in increased power consumption as well as higher production costs. Moreover, while a full-automatic washing machine employing a pulsator enables adoption of a method of partially rotating the tub as well as the pulsator, creating a dual-drum motion effect, a washing machine having one drum

has difficulty in achieving such an effect since the drum is rotated by one motor only.

SUMMARY OF THE INVENTION

[0012] Accordingly, the present invention is directed to a dual motor drum type washing machine that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

[0013] An object of the present invention, which has been devised to solve the foregoing problem, lies in providing a dual-motor drum-type washing machine, which reduces production costs and enhances washing and dewatering performance, by using a washing motor and a dewatering motor separately, and by enabling the dual-drum motion effect of a pair of drums through an appropriate control of the motors.

[0014] Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent to those having ordinary skill in the art upon examination of the following or may be learned from a practice of the invention. The objectives and other advantages of the invention will be realized and attained by the subject matter particularly pointed out in the specification and claims hereof as well as in the appended drawings.

[0015] To achieve these objects and other advantages in accordance with the present invention, as embodied and broadly described herein, there is provided a dual-motor drum-type washing machine comprising a washing motor; a washing pulley connected to the washing motor by a belt, the washing pulley having a first shaft wherein a sun gear is formed at a front end of the first shaft; a plurality of planetary gears engaging with the sun gear; a first drum connected to a second shaft extending from a center of a rotational plate ganging shafts of the planetary gears; a dewatering motor; a dewatering pulley connected to the

dewatering motor by a belt, the dewatering pulley having a first connecting part penetrated by the first shaft; a cylindrical inner gear case coupled to a front end of the first connecting part, to house the sun and planetary gears, the cylindrical inner gear case having teeth formed on an inner circumferential surface; a second connecting part extending from a central portion of the inner gear case to be penetrated by the second shaft; and a second drum coupled to a front end of the second connecting part.

[0016] Preferably, the rotational speed ratio of the washing motor to the washing pulley is set to 6:1, by adjusting the respective diameters of its motor and pulleys; and the rotational speed ratio of the dewatering motor to the dewatering pulley is preferably set to 1.4:1, by adjusting the respective diameters of its motor and pulleys.

[0017] Preferably, the washing and dewatering motors are induction motors.

[0018] It is to be understood that both the foregoing explanation and the following detailed description of the present invention are exemplary and illustrative and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

[0020] FIG. 1 is a cross-sectional view of a drum-type washing machine according to a related art;

[0021] FIG. 2 is a cross-sectional view of a dual-motor drum-type washing machine according to a preferred embodiment of the present invention; and

[0022] FIG. 3 is a simplified rear view of the dual-motor drum-type washing machine of FIG. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0023] Reference will now be made in detail to the preferred embodiment of the present invention, examples of which are illustrated in the accompanying drawings. Throughout the drawings, like elements are indicated using the same or similar reference designations where possible.

[0024] Referring to FIG. 2, a dual-motor drum-type washing machine according to a preferred embodiment of the present invention includes a washing motor 50 (shown as the motor's pulley) operated on washing. A first shaft 70 extends from the center of a washing pulley 52 connected to the pulley of a washing motor 50 by a V-belt 51 to be driven, and a sun gear 72 lying between a plurality of planetary gears 74 is formed at a front end of the first shaft 70. As the sun gear 72 rotates, the planetary gears 74 simultaneously rotate. The sun and planetary gears 72 and 74 are housed in an inner gear case 90, which itself rotates to transfer a rotational force. The inner gear case 90 is provided with a plurality of teeth formed on its inner circumferential surface for meshing with the planetary gears 74. The inner gear case 90 is substantially cylindrical and prevents the separation of the planetary gears 74 from the sun gear 72.

[0025] The centers of the planetary gears 74 are commonly fixed to a rotational plate 76, such that their rotation about the sun gear 72 is ganged, and a second shaft 80 extends from the center of the rotational plate 76 to be coupled to a first drum 101. Thus, the first drum 101 is rotated by a motion of the rotational plate 76 and the planetary gears 74 rotating in unison but in opposite directions on opposite sides of the sun gear 72.

[0026] A dewatering pulley 62 coupled to a dewatering motor 60 (shown as the motor's pulley) by a V-belt 61 is provided in front of the washing pulley 52. A shaft passage hole is formed at a center of the dewatering pulley 62, and a cylindrical first connecting part 91 is formed to coincide with the hole. The first shaft 70 of the washing pulley 52 passes through the shaft passage hole and the first connecting part 91, and a bearing is installed between the first shaft 70 and the first connecting part 91 to facilitate a rotation of the first shaft 70. The first connecting part 91 communicates with the inner gear case 90.

[0027] A second connecting part 92 is installed at one side of the inner gear case 90, opposite the first connecting part 91. The second connecting part 92 has a cylindrical shape through which the second shaft 80 passes, and a bearing is provided to facilitate a rotation of the second shaft 80. The second connecting part 92 is coupled to a second drum 102, the interior of which is provided with the first drum 101, to transfer a rotational force to the second drum 102.

[0028] The above-explained first shaft 70, second shaft 80, first connecting part 91, and second connecting part 92 are rotatably installed. The first and second connecting parts 91 and 92 are coupled to a fixing part connected to the tub 2 of the drum-type washing machine by bearings to facilitate their rotations.

[0029] Referring to FIG. 3, the washing and dewatering pulleys 52 and 62 are provided at the center of the tub 2 of the drum-type washing machine, the washing pulley 52 is coupled to the washing motor 50 by the V-belt 51, and the dewatering pulley 62 is coupled to the dewatering motor 60 by the other V-belt 61.

[0030] The washing and dewatering motors 50 and 60 are induction-type motors. Compared to the motor of the related art drum-type washing machine, which is the expensive BLDC or universal motor of high power consumption, the induction motor of low power

consumption is inexpensive since it provides a uniform rotational speed and enables only forward and reverse rotations.

[0031] The rotational speed ratio of the washing motor 50 to the washing pulley 52 is preferably set to 6:1. Such a reduction ratio is adjusted by a diameter difference or gear ratio between the motor and pulley. Meanwhile, the rotational speed ratio of the dewatering motor 60 to the dewatering pulley 62 is preferably set to 1.4:1.

[0032] The washing motor 50 has a characteristic of periodically rotating the first drum 101 clockwise or counterclockwise, so that a simple motor enabling forward and reverse rotation may be employed, while the dewatering motor 60 is only used to perform dewatering the laundry by a unidirectional high-speed rotation, so that a motor of correspondingly limited characteristic may be employed. Hence, a motor that is less expensive and consumes less power than the washing motor 50 is applicable as the dewatering motor 60.

[0033] In the operation of the dual-motor drum-type washing machine, the washing motor 50 cyclically rotates in the forward or reverse direction on performing a washing step. In case of a short cycle, the following operation takes place.

[0034] As the washing pulley 52 is rotated by a rotation of the washing motor 50 to rotate the first shaft 70 of the washing pulley 52, the sun gear 72 at the front end 70 of the first shaft 70 rotates. The planetary gears 74 are then rotated by a rotation of the sun gear 72 to considerably reduce the rotational speed of the planetary gears 74. Here, the rotational speed ratio of the sun gear 72 to the rotational plate 76 is preferably set to 5.5:1.

[0035] Thus, the rotational movement by the sun gear 72 is transferred to the rotational plate 76 ganging the planetary gears 74, and the reduced rotational force rotates the first drum 101 through the second shaft 80.

[0036] In case that the cycle of the forward/reverse rotation is short, the inner gear

case 90 connected to the dewatering pulley 62 is rotated in the reverse direction by a reaction of a gear mechanism when the sun gear 72 rotates in the forward direction. A rotational force of the inner gear case 90 is transferred to the second drum 102 so that the first and second drums 101 and 102 rotate in opposing directions.

[0037] Such a motion, which achieves the same effect as that of the dual-drum washing method of a pulsator-type washing machine, is achieved by a pair of drums cyclically rotating in opposing directions, to enable the laundry to be evenly soaked in the water and detergent.

[0038] In case that the cycle of the forward/reverse rotation of the washing motor 50 is long, the following operation takes place.

[0039] In an initial rotation of the washing pulley 52, the first and second drums 101 and 102 first rotate in opposing directions. After a predetermined time passes, the first drum 101 eventually rotates in the direction of the second drum 102 by an inertial force. Thus, the method of the related art drum-type washing machine is implemented.

[0040] Motor operation in a dewatering step is now explained.

[0041] First of all, the washing and dewatering motors 50 and 60 are simultaneously driven in the forward direction on dewatering after completion of washing. In case of the driving of the two motors, an initial motive power is enhanced to accelerate the simultaneous rotational speeds of the first and second drums 101 and 102.

[0042] If the washing motor 50 is turned off so that the second drum 102 is rotated by the dewatering motor 60 only, the first drum 101 also rotates as a result of the inertial force. In controlling the rotational speeds of the first and second drums 101 and 102, the dewatering motor 60 is appropriately turned on/off to control their speeds.

[0043] Accordingly, the dual-motor drum-type washing machine according to the

present invention has the following advantages of effects.

[0044] First, induction motors are used as the washing and dewatering motors to reduce product cost.

[0045] Second, a pair of the drums are driven separately by respective motors, to enable dual-drum washing, so that washing efficiency is enhanced and power consumption is reduced.

[0046] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover such modifications and variations, provided they come within the scope of the appended claims and their equivalents.